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Preliminary Feasibility Study of Resource Recovery for Greensboro, High Point, and Winston-Salem, North Carolina (Appendices - Phase I)

CSI Resource Systems, Inc.
Boston, MA

Prepared for

Environmental Protection Agency
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Solid Waste

EPA

A TECHNICAL ASSISTANCE PROGRAM REPORT

PRELIMINARY FEASIBILITY STUDY OF RESOURCE RECOVERY FOR GREENSBORO, HIGH POINT AND WINSTON-SALEM, NORTH CAROLINA

APPENDICES

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Technical assistance by personnel teams. 42 USC 6913

RESOURCE RECOVERY AND CONSERVATION PANELS

SEC. 2003. The Administrator shall provide teams of personnel, including Federal, State, and local employees or contractors (hereinafter referred to as "Resource Conservation and Recovery Panels") to provide States and local governments upon request with technical assistance on solid waste management, resource recovery, and resource conservation. Such teams shall include technical, marketing, financial, and institutional specialists, and the services of such teams shall be provided without charge to States or local governments.

This report has been reviewed by the Project Officer, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Project Officer: Elmer G. Cleveland

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This report, which is part of a three volume Phase I technical assistance to Greensboro, High Point, and Winston Salem, North Carolina, is supplementary to the Technical Report. This volume is restricted to: detailing abbreviations and definitions, economic and technical assumptions, calculations and technical data, flow diagrams of municipal solid waste deliveries, and a market interview questionnaire.

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Solid Waste; Resource Recovery - Modular Combustion; Waterwall Combustion; Refuse Derived Fuel (R.D.F.); Transfer; Phase I; Shredding; Dedicated Boiler System

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Cities of Greensboro, High Point, and Winston Salem (North Carolina)
Counties of Guilford and Forsyth (North Carolina)
Piedmont Triad louncil of Governments (P.T.C.O.G.)

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PRELIMINARY FEASIBILITY STUDY
OF
RESOURCE RECOVERY FOR
GREENSBORO, HIGH POINT AND WINSTON-SALEM, NORTH CAROLINA

APPENDICES

PREPARED FOR

OFFICE OF SOLID WASTE MANAGEMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV, ATLANTA, GEORGIA

BY

CSI RESOURCE SYSTEMS, INC.
BOSTON, MASSACHUSETTS

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ABBREVIATIONS AND DEFINITIONS

A/E	:	Architect/Engineer
Btu	:	British Thermal Unit
HHV	:	Higher Heating Value
KWH	:	Kilowatt Hour
Mil	:	= 1/10 of 1 cent
/mm	:	per million
MSW	:	Municipal Solid Waste
OBM	:	Oversized Bulky Materials
O, M & R	:	Operations, Maintenance and Replacements
OPEC	:	Organization of Petroleum Exporting Countries
RDF	:	Refuse Derived Fuel
TPD_5	:	Tons per day (5-day week)
TPD_6	:	Tons per day (6-day week)
TPD_7	:	Tons per day (7-day week)

ECONOMIC AND TECHNICAL ASSUMPTIONS

Assumptions

For consistency and comparative purposes, 1983 is the reference period for determining the capital requirements and net disposal costs of each system. In developing the 1983 economics for each of the resource recovery options, the following assumptions were made:

- The design and construction of the decentralized RDF system is competitively bid with ownership and operational responsibility for the respective facilities held by the participating communities and Duke Power
- To minimize the risk to the participating communities all other systems would be designed, constructed, owned and operated by a private sector vendor and/or energy buyer under a full service contract
- Capital costs escalate at a rate of 14 percent per year (linear)
- Operations, maintenance and repair elements escalate at a rate of 10 percent per year (linear)
- Labor costs escalate at a rate of 12 percent per year (linear)
- Fuel costs escalate at the rate of 15 percent per year (compounded)
- To minimize debt service costs to the participating communities and to maximize tax benefits available to the private sector full service Contractor, an equity participation representing 30 percent of the project capital costs is made for each of the waterwall combustion and modular combustion options
- The various systems are financed utilizing tax exempt industrial revenue bonds or general obligation bonds

The efficient disposal operations currently enjoyed by all three cities and High Point's several years of solid waste shredding experience suggests that the most cost-effective procurement

and operational/ownership strategy may be for the RDF processing and transfer facilities to be competitvely bid and owned and operated by each city. The modifications necessary to enable the Belews Creek facility to utilize RDF would be the responsibility of Duke Power; ownership and operation of the facility would be by Duke Power. However, the intrinsic technical and economic risks attendant with the other resource recovery options, and each community's lack of experience in operating same, favors a full-service procurement and ownership/operational strategy. The opportunity to realize reasonable profits in the construction and operation of a resource recovery facility, particularly if profit-sharing incentives are offered, should be sufficient incentive for the system contractor to shoulder the risks. It should be pointed out that there are certain risk elements that a contractor cannot control, such as changes in characteristics of the waste stream and changes in environmental standards, which could have adverse impacts upon the performance or economics of a particular system.

The burden of these force majeure risks, while unlikely to occur, may not be readily shifted to the system vendor. As a consequence, under a full-service contract, there still remain some risks for the participating communities.

Preliminary capital projections for the RDF system include modifications to the existing High Point and Greensboro shredder complexes; the construction of a new shredder facility at Winston-Salem; modifications to the Belews Creek coal-fired boiler and attendant material handling equipment and RDF storage facilities were developed from engineering factored estimates based on flow charts and concept designs. As a further check against the resultant first order capital projections, current pricing information was acquired from representative manufacturers of solid waste shredding; conveying and handling; trommeling and processing equipment.

The capital costs of the various waterwall combustion and modular combustion systems were also developed from engineering factored estimates based upon flow charts and concept design. And

the projected capital costs were then referenced against bids for resource recovery systems of similar technology and comparable scale recently submitted by several full service vendors.

The capital; operation, maintenance and repairs (O, M&R); and labor cost estimates were escalated on a linear basis at the rate of 14, 10, and 12 percent per year, respectively, until late 1983 when one or more of the large scale resource recovery options presented could be first operational. While the modular combustion systems could be operational within twenty-four to thirty months of firm commitment, for sake of comparison the year 1983 has been utilized as the reference period for all of resource recovery options. These escalators reflect the trend of inflation impacts upon these various cost elements.

For the sake of analysis, fuel costs are assumed to increase at a compound annual rate of 15 percent. The 1979 base fuel price from which 1983 estimated energy revenues are developed varied widely between prospective energy customers. As an example, January 1979 residual oil prices for the prospective energy customers ranged from a low of $0.315/gallon to a high of $0.385/gallon. In part, this price variance is due to differences in purchasing practices, with the remainder accounted for by variations in sulfur content.

To the extent that these escalators are understated, 1983 projected revenues for each potential resource recovery system will also be understated. Since January, there have been dramatic price increases in fuel, the effect of which could be to render the revenue projections already obsolete.

Revenue projections are customer-specific and are developed from January 1979 prevailing fuel costs to the prosective customers. While there are other costs, including labor, capital and maintenance costs incurred in converting oil, gas, coal or other fuels into a desired product--steam, hot water, or electricity--revenue projections are based solely on the fuel component.

In order to minimize the debt service expenses incurred by the waste generating communities for a given system, the assumption was made that an equity participation of 30 percent would be

available by a private sector investor, either the owner/operator of the resource recovery system, or the ultimate customer of the energy from such a system. This assumption held for each of the resource recovery options, with the exception of the decentralized RDF system which would be 100 percent owned and operated by the respective participating cities.

The advantages of private sector equity participation is two-fold. First, the debt service costs to the participating community are substantially reduced. As an example, the debt service on the 625 TPD_7 waterwall combustion system with steam produced for sale to Lorillard and A & T University are reduced by nearly $5.00 per ton to $11.60 per ton. Without an equity participation of 30 percent the resultant debt service costs would be commensurately higher. Second, by making an equity participation, the system vendor or energy consumer is able to take advantage of significant tax benefits including an Investment Tax Credit and accelerated depreciation on the capital cost of the system (exclusive of site acquisition and development costs).

Under the full service contract, risk to a city is minimized because the selected vendor is responsible for the design, construction and operation of the system. The responsibility of the participating community or communities is limited to the delivery of the contracted quantities of waste and payment of a fee as set forth in an agreement between the city and the resource recovery plant operator.

The requirement that the prospective energy purchaser or the system vendor invest in the system by taking an equity position could complicate matters, making the implementation of a given resource recovery project more difficult. However, it is felt that the advantages to the communities in minimizing risk and the advantages to a private sector owner/operator, in the form of significant tax benefits and profits from operating the system, results in the best ownership/operation option available.

GREENSBORO 625 TPD_7 WATERWALL COMBUSTION SYSTEM
WITH STEAM PRODUCED FOR SALE TO LORILLARD AND A & T UNIVERSITY

ASSUMPTIONS:

- 4500 Btu/lb MSW
- System operates 365 days/year; 24 hours/day
- 83% availability factor
- 68% system thermal efficiency
- Steam produced at 250 psig, 396° F., sold at 150 psig
- System produces 132,600 lbs steam/hour
- Steam sales approximate 79% of steam production
- Debt service based upon 7% financing, 25-year terms, 30% private sector equity investment
- Residual disposal cost of $4.00/input ton, based on projected cost of residual disposal of $20.00/ton
- Revenues predicated upon:

  Lorillard:

  1983 fuel cost = $4.40/mm Btu
  1983 steam cost =$6.21/1000 lbs.

  A & T University:

  1983 fuel cost = $4.20/mm Btu
  1983 steam cost= $5.96/1000 lbs.

GREENSBORO 625 TPD_7 WATERWALL COMBUSTION SYSTEM
WITH STEAM AND ELECTRICITY PRODUCED FOR SALE TO LORILLARD

ASSUMPTIONS:

- 4500 Btu/lb MSW
- System operates 365 days/year, 24 hours/day
- 83% operating factor
- 68% system efficiency
- 4523 lbs of steam/ton MSW at 600 psig, 700° F.
- Approximately 1353 Btu/lb of steam
- System produces ≈ 117,600 lbs of steam/hour
- 100,000 lbs of steam extracted at 150 psig for sale, 24 hrs/day, 260 days/yr
- 1 kwh = 10 lbs of steam at 600 psig, 700° F. (condensed)
  50 lbs of steam at 600 psig, 700° extracted at 150 psig
- 10% internal electricity consumption
- Debt Service based upon 7% financing, 25-year terms, 30% private sector equity participation
- Revenues predicated upon:
  - Steam: 1983 projected fuel cost =$4.40/mm Btu
    624,000,000 lbs of steam sold at $6.21/1000 lbs.
  - Electricity: 1983 projected retail price of $4.37/kwh
    1983 projected wholesale price of $2.19/kwh
    12,480,000 kwh sold at retail
    43,440,000 kwh sold at wholesale.

GREENSBORO 470 TPD_6 WATERWALL COMBUSTION SYSTEM WITH STEAM PRODUCED FOR SALE TO CONE

ASSUMPTIONS:

- 4500 Btu/lb MSW
- System operates 312 days/year, 24 hours/day
- 83% availability factor
- 68% system thermal efficiency
- Steam produced at 250 psig, 396^{o} F, sold at 150 psig
- System produces 100,000 lbs steam/hour
- Steam sales approximate 88% of aggregate steam production
- Debt service based upon 7% financing, 25-year terms, 30% private sector equity investment
- Residual disposal cost of $4.00/input ton, based on projected cost of residual disposal of $20.00/ton
- Steam revenues predicated upon:
  1983 projected fuel cost = $3.54/mm Btu
  = $5.15/1,000 lbs steam (at 150 psig)

GREENSBORO 625 TPD_7 WATERWALL COMBUSTION SYSTEM
WITH STEAM AND ELECTRICITY PRODUCED
FOR SALE TO CONE

ASSUMPTIONS:

- 4500 Btu/lb MSW
- System operates 365 days per year, 24 hours per day
- 83% operating factor
- 68% system efficiency
- 4523 lbs of steam/ton MSW at 600 psig, 700° F.
- Approximately 1353 Btu/lb of steam
- System produces ≈ 117,600 lbs of steam/hour
- Steam extracted at 150 psig for sale
- 1 kwh = 10 lbs of steam at 600 psig, 700° F. (condensed)
  50 lbs of steam at 600 psig, 700° F. and extracted at 150 psig
- 10% internal electricity consumption
- Debt Service based upon 7% financing, 25-year terms
- Revenues predicated upon:

  Steam: 1983 projected fuel cost = $3.67/mm Btu
  499,200,000 lbs of steam sold at $5.15/1000 lbs.

  Electricity: 1983 projected retail price of $.0437/kwh.
  1983 projected wholesale price of $.0219/kwh.
  28,080,000 KWH sold at retail
  34,486,000 KWH sold at wholesale

HIGH POINT 90 TPD_6 MODULAR COMBUSTION SYSTEM
WITH STEAM PRODUCED FOR SALE TO J. P. STEVENS

ASSUMPTIONS:

- 4500 Btu/lb MSW
- System assumes solid waste 6 days/week, 50 weeks/year
- 90% availability
- 65% system thermal efficiency
- Steam produced and sold at 150 psig
- System produces 18,375 lbs steam/hour
- Debt Service based upon 7%, 20-year terms, 30% private sector equity investment
- Revenues predicated upon:

  J. P. Stevens current cost of fuel = $2.47/mm Btu
  = $3.60/1000 lbs steam

  J. P. Stevens 1983 projected cost of fuel = $4.34/1000 lbs steam
  = $6.30/1000 lbs steam

  17,000 lbs steam/hr x 24 hrs x 5.5 days x 50 weeks
  = 112,200,000 lbs of steam sold

WINSTON-SALEM 250 TPD_5 MODULAR COMBUSTION SYSTEM WITH STEAM PRODUCED FOR SALE TO HANES

ASSUMPTIONS:

- 4500 Btu/lb MSW
- System operates 260 days/year, 24 hours/day
- 76% availability factor, six 55 TPD modules: 5 to be operated, 1 for backup
- 65% system thermal efficiency
- Steam is produced and sold at 150 psig
- System produces 51,000 lbs steam/hour
- Steam sales approximate 88% of steam production
- Debt Service based upon 7% financing, 20-year terms, 30% private sector equity investment
- Revenues predicated upon:
  - Hanes current cost of fuel = $2.07/mm Btu = $2.90/1000 lbs steam
  - Hanes 1983 projected cost of fuel = $3.60/mm Btu = $5.07/1000 lbs steam

DERIVATION OF 1983 RDF REVENUES

Current delivered fuel costs = $1.28/$10^6$ Btu's

Escalated at 15 percent per year for 4 years = $2.24/$10^6$ Btu's

RDF at 9 x 10^6 Btu/ton = 9 x $2.24 = $20.16/ton

$20.16	1)	Gross Equivalent Value RDF
11.29	2)	Convert to Solid Waste Tonnage Basis (56% of #1)
<1.35>	3)	Derating Offset (12% of #2)
<1.69>	4)	O, M & R Offset (15% of #2)
<1.65>	5)	Debt Service*
	6)	Ash Disposal
$ 6.60		NET VALUE RDF ON SOLID WASTE INPUT BASIS

*Debt Service based on capital costs of $6,240,000 less 10% investment, tax credit totaling $624,000, available to Duke Power, amortized over 15 years at 18% cost of capital. Revenues and offsets are converted from an RDF basis to solid waste input basis.

DERIVATION OF WEIGHTED AVERAGE DISPOSAL COSTS FOR 1015 TPD_6 DECENTRALIZED RDF ALTERNATIVE

1) Annual Solid Waste Generation:

Greensboro	284,710
High Point	78,070
Winston-Salem	202,960
TOTAL	565,740

2) Pro Rata Waste Generation:

Greensboro:	284,710/565,740 = .503
High Point:	78,070/565,740 = .138
Winston-Salem:	202,960/565,740 = .359

3) Weighted Average Disposal Costs for Regional RDF System:

$$8.00(.503) + 19.00(.138) + 11.20(.359) \simeq \$10.70$$

GREENSBORO RDF TRANSFER STATION
($530\ TPD_6$)
1979 O & M COST ESTIMATES

DIRECT LABOR:	
1 manager @ $18,000	$ 18,000
10 drivers (includes 1 spare) @ $11,500	115,000
2 mechanics @ $12,600	25,200
4 compactor operators (includes 1 spare) @ $10,200	40,800
1 bookkeeper @ $10,400	10,400
1 weigh clerk/secretary @ $10,400	10,400
	$219,800
FRINGES (25%)	56,000
TOTAL LABOR COSTS	$275,800
ROLLING STOCK:	
Fuel	$ 96,000
Oil, tires, A/C, transmission	55,000[2]
Maintenance & repairs	32,000[3]
Insurance	18,500[4]
	$201,500
ADDITIONAL EXPENSES:	
Insurance	$ 5,000
Taxes	N/A
Electricity, telephone, heat, water	28,500
Maintenance & repairs for compactor equipment	15,000
	$ 48,500
DEBT SERVICE	$ 84,900
CONTINGENCY	$ 61,000
TOTAL ANNUAL COSTS	$671,000
PER TON COST OF TRANSFER (MSW basis)	$2.40

1983 GREENSBORO TRANSFER STATION

CAPITAL AND O & M COST ESTIMATES

SOLID WASTE AVAILABLE (tons):			284,710
RDF SHIPPED (tons):			159,450
	1979 Costs	Escalation Factor	1983 Costs
CAPITAL COSTS:	$360,000	(1.56)	$562,000
ANNUAL COSTS:			
Labor	275,800	(1.48)	408,000
Rolling Stock	201,500	(1.40)	282,000
Additional Expenses	48,500	(1.40)	68,000
Debt Service			130,000
			888,000
Contingency (10%)			89,000
TOTAL ANNUAL COSTS			$977,000
PER TON COST OF TRANSFER (MSW basis)			$3.40

Note: Per ton cost and revenue elements are on a dollar basis. All other cost and revenue elements are in thousands (dollars).

GREENSBORO RDF TRANSFER STATION

530* TPD_6

TRANSFER EQUIPMENT:		
Rolling Stock[1]		
5 tractors @ $50,000	$250,000	
5 trailers @ $20,000	100,000	
1 maintenance vehicle @ $10,000	10,000	
		$360,000
COMPACTOR EQUIPMENT[2]		0
TOTAL CAPITAL COST		$ 360,000

[1] 4 tractor/trailers previously purchased.
[2] 4 compactors previously purchased.
* Assumes RDF ≈ 56% of MSW input.

GREENSBORO RDF TRANSFER STATION

530 TPD_6*

1. One-Way Distance ≈ 30 miles
2. Average Highway Speed = 40 mph
3. Time at Loading Station = 7 minutes
4. Time at Belews Creek, weigh and discharge = 7 minutes
5. Round Trip Time = 104 minutes
6. At 7 hours/day = 420 minutes/day
7. 420/104 = 4.04 Round Trips/day
8. Number of Trailer Loads:

   530 tons/17-18 tons/trailer = 30.29 trailer loads/day
9. Tractor/Trailer Requirements:

   30.29 trailer loads/day

   - At 90% availability: $\frac{8}{.9}$ = 8.89 ≈ 9 tractor/trailer

*Assumes 300 working days/year.

ASSUMPTIONS:

1. Fuel Costs
   - diesel fuel at 70¢/gallon
   - trucks get 4 miles/gallon

2. Oil, tires, A/C, transmission
   - at 10¢/mile

3. Maintenance and Repairs
   - at 5% of capital cost/year

4. Insurance
   - $2,000/tractor and trailer set
   - $500/maintenance vehicle

5. Debt Service
   - 5-year life, 7.5% cost of capital for transfer equipment
   - 15-year life, 6% cost of capital for compactor equipment

6. Escalators (linear)
   - Capital at 14%
   - Labor at 12%
   - Others at 10%

1983 HIGH POINT RDF TRANSFER STATION

CAPITAL AND O & M COST ESTIMATES

SOLID WASTE AVAILABLE (tons):			78,070
RDF SHIPPED (tons):			43,720
	1979 Costs	Escalation Factor	1983 Costs
CAPITAL COSTS:	$155,000	(1.56)	$242,000
ANNUAL COSTS:			
Labor	$134,500	(1.48)	199,000
Rolling Stock	74,500	(1.40)	104,000
Additional Expenses	23,700	(1.40)	33,000
Debt Service			40,000
			376,000
Contingency (10%)			38,000
TOTAL ANNUAL COSTS:			414,000
PER TON COST OF TRANSFER (MSW basis)			$ 5.30

Note: Per-ton cost and revenue elements are on a dollar basis. All other cost and revenue elements are in thousands (dollars).

HIGH POINT RDF TRANSFER STATION
(145 TPD_6)
1979 O & M COST ESTIMATES

DIRECT LABOR:		
1 manager @ $18,000	$ 18,000	
4 drivers (includes 1 alternate) @ 11,500	46,000	
1 mechanic @ $12,600	12,600	
1 compactor operator @ $10,200	10,200	
1 bookkeeper @ $10,400	10,400	
1 weigh clerk/secretary @ $10,400	10,400	
		$107,600
FRINGES (25%):		26,900
TOTAL LABOR COSTS:		$134,500
ROLLING STOCK:		
Fuel	$ 35,000[1]	
Oil, tires, A/C, transmission	20,000[2]	
Maintenance/repairs	11,000[3]	
Insurance	8,500[4]	
		$ 74,500
ADDITIONAL EXPENSES:		
Insurance	$ 2,500	
Taxes	N/A	
Electricity, telephone, heat, water	10,000	
Fuel	3,700	
Maintenance/repairs for compactor equipment	7,500	
		$ 23,700
DEBT SERVICE		$ 25,700
CONTINGENCY (10%)		$ 25,800
TOTAL ANNUAL COSTS		$284,000
PER TON COSTS OF TRANSFER (MSW basis)		$3.65

1979 CAPITAL COST ESTIMATES

HIGH POINT RDF TRANSFER STATION

145* TPD_6

Transfer Equipment	
Rolling Stock[1]	
1 tractor @ 50,000	$ 50,000
1 trailer @ 20,000	20,000
1 maintenance vehicle @ 10,000	10,000
	$ 80,000
Compactor Equipment[2]	
1 - 30 TPH compactor @ 75,000	75,000
TOTAL CAPITAL COST	$155,000

[1] 2 tractor/trailers previously purchased.

[2] 1 compactor previously purchased.

* Assumes RDF = 56 percent of MSW input.

HIGH POINT RDF TRANSFER STATION

145 TPD_6*

1. One way distance = 40 miles
2. Average Highway Speed = 40 mph
3. Time at loading station = 7 minutes
4. Time at Belews Creek, weigh and discharge = 7 minutes
5. Round trip time = 134 minutes
6. At 7 hours/day = 420 minutes/day
7. $\frac{420 \text{ minutes}}{134} = 3.13$ Round trips/day
8. Number of Trailer loads: $\frac{145 \text{ tons}}{17\text{-}18 \text{ tons/trailer}} = 8.29$ trailerloads/day
9. Tractor/trailer requirements: $\frac{8.29 \text{ trailer loads/day}}{3.13 \text{ RT/day}} = 2.65$ tractor/trailer

- At 90% availability: $\frac{2.65}{.9} = 2.94 \approx 3$ tractor/trailers

*Assumes 300 working days/year.

ASSUMPTIONS:

1. Fuel Costs
   - Diesel fuel at 70¢/gallon
   - Trucks get 4 miles/gallon
2. Oil, tires, A/C, transmission
   - At 10¢/mile
3. Maintenance and Repairs
   - At 5% of capital cost/year
4. Insurance
   - $2,000/tractor and trailer set
   - $500/maintenance vehicle
5. Debt Service
   - 5-year, 7.5% cost of capital for transfer equipment
   - 15-year life, 6% cost of capital for compactor equipment
6. Escalators (linear)
   - Capital at 14%
   - Labor at 12%
   - Others at 10%

1983 WINSTON-SALEM TRANSFER STATION

CAPITAL AND O & M COST ESTIMATES

SOLID WASTE AVAILABLE (tons):			202,960
RDF SHIPPED (tons):			113,660
	1979 Costs	Escalation Factor	1983 Costs
CAPITAL COSTS:	$585,000	(1.56)	$ 13,000
ANNUAL COSTS:			
Labor	161,600	(1.48)	240,000
Rolling Stock	105,500	(1.40)	148,000
Additional Expenses	40,250	(1.40)	56,000
Debt Service			163,000
			607,000
Contingency (10%)			61,000
TOTAL ANNUAL COSTS			$ 668,000
PER TON COST OF TRANSFER (MSW basis)			$3.30

Note: Per Ton cost and revenue elements are on a dollar basis. All other cost and revenue elements are in thousands (dollars).

WINSTON-SALEM RDF TRANSFER STATION
($380\ TPD_6$)*
1979 O & M COST ESTIMATES

DIRECT LABOR:	
1 manager @ $18,000	$ 18,000
5 drivers (includes 1 spare) @ $11,500	57,500
1 mechanic @ $12,600	12,600
2 compactor operators @ $10,200	20,400
1 bookkeeper @ $10,400	10,400
1 weigh clerk/secretary @ $10,400	10,400
	$129,300
FRINGES (25%):	32,300
TOTAL LABOR:	$161,600
ROLLING STOCK:	
Fuel	$ 49,000[1]
Oil, tires, A/C, transmission	28,000[2]
Maintenance & repairs	18,000[3]
Insurance	10,500[4]
	$105,500
ADDITIONAL EXPENSES:	
Insurance	$ 2,500
Taxes	N/A
Electricity, telephone, heat, water	19,000
Fuel	7,500
Maintenance & repairs to compactor equipment	11,250
	$ 40,250
DEBT SERVICE:	$105,000
CONTINGENCY (10%)	41,000
TOTAL ANNUAL COSTS	454,000
PER TON COST OF TRANSFER (MSW basis)	2.24

1979 CAPITAL COST ESTIMATES
WINSTON-SALEM RDF TRANSFER STATION
380* TPD_6 (300 day basis)

TRANSFER EQUIPMENT:	
Rolling Stock	
5 tractors @ 50,000	$250,000
5 trailers @ 20,000	100,000
1 maintenance vehicle @ 10,000	10,000
	360,000
COMPACTOR EQUIPMENT:	
3 30TPH compactors @ 75,000	225,000
TOTAL CAPITAL COST:	$585,000

*Assumes RDF = 56% of MSW input

WINSTON-SALEM RDF TRANSFER STATION

380 TPD_6*

1. One way = 15 miles
2. Average highway speed - 30 mph
3. Time at loading station - 7 minutes
4. Time at Belew's Creek, weigh and discharge - 7 minutes
5. Roundtrip time - 74 minutes
6. At $\frac{7 \text{ hrs}}{\text{day}} = \frac{420 \text{ minutes of work}}{\text{day}}$
7. $\frac{420}{74} = \frac{5.68 \text{ roundtrips}}{\text{day}}$
8. Number of trailer loads:
   380 tons/17-18 tons/trailer = 21.71 trailer loads
9. Tractor/trailer requirements:
   $\frac{21.71 \text{ trailer loads/day}}{5.68 \text{ RT/day}} = 3.82 = 4$ tractor/trailers

- At 90% tractor availability $= \frac{4}{.9} = 4.44 = 5$ tractors

*Assumes 300 working days/year

ASSUMPTIONS:

1. Fuel Costs
   - Diesel fuel at 70¢/gallon
   - Trucks get 4 miles/gallon

2. Oil, tires, A/C, transmission
   - At 10¢/mile

3. Maintenance and Repairs
   - At 5% of capital cost/year

4. Insurance
   - $2000/tractor and trailer set
   - $500/maintenance vehicle

5. Debt Service
   - 5-year life, 7.5% cost of capital for transfer equipment
   - 15-year life, 6% cost of capital for computer equipment

6. Escalators (linear)
   - Capital at 14%
   - Labor at 12%
   - Others at 10%

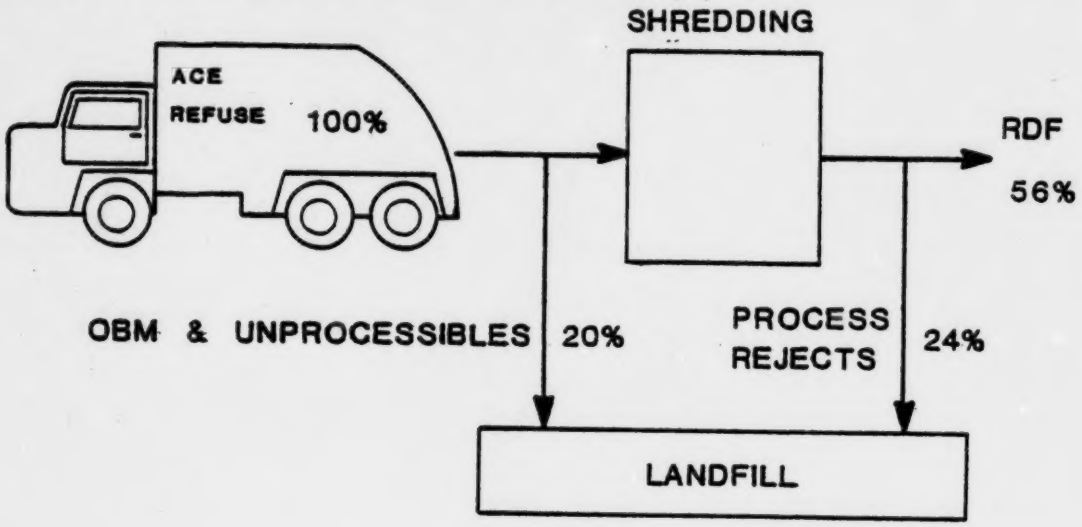
CALCULATION OF GREENSBORO 1983 RESIDUAL DISPOSAL COSTS

ASSUMPTIONS:

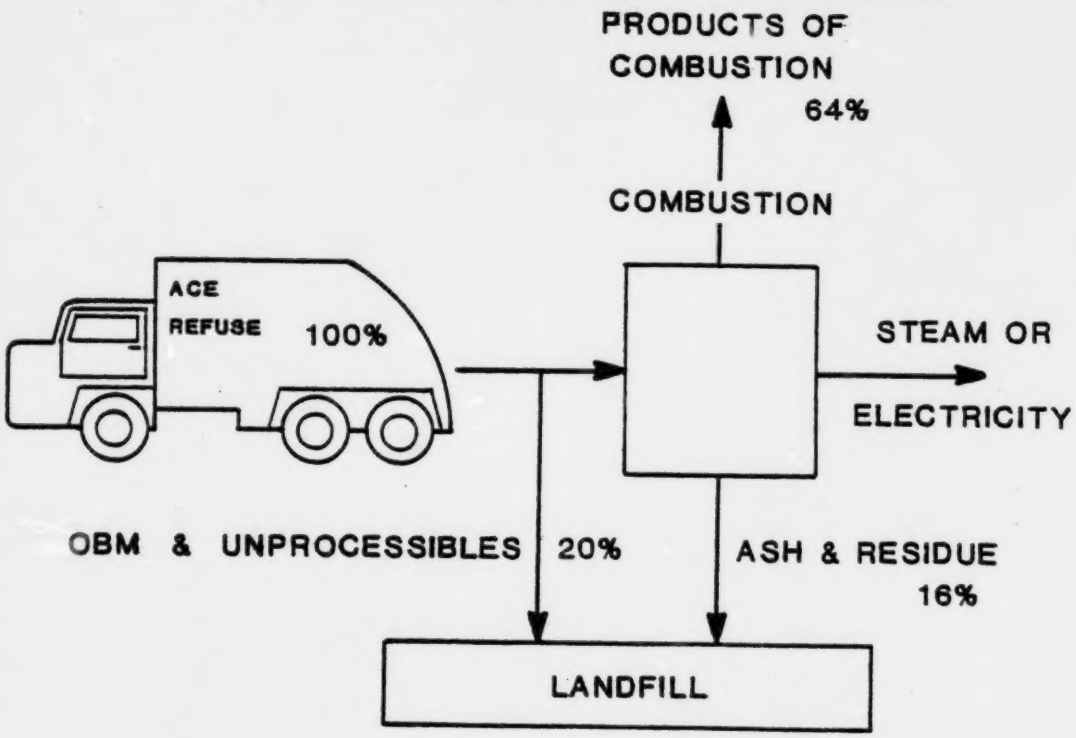
- 20% of waste unprocessible (weight basis)
- 25% of combusted waste (weight basis = residual)
- Per-ton cost of landfilling unprocessibles
  = 2 X projected landfill costs = $5.60
- Per-ton cost of landfill combusted residue = $20

FLOW DIAGRAM OF MSW DELIVERIES

REFUSE DERIVED FUEL SYSTEM:



WATERWALL COMBUSTION AND MODULAR COMBUSTION SYSTEMS:



NAME OF ORGANIZATION:

LOCATION:

TYPE OF ACTIVITY:

PERSON(S) INTERVIEWED:

This is

Parent_____

Branch Plant_____

_____

Division of_____

_____

Subsidiary of_____

_____

How long in business in this area?

How Long operating at this location?

	Current	Compared to 1 year ago	Compared to 5 years ago
TOTAL EMPLOYMENT	_____	_____	_____

	Shifts/day	Days/week	Start of 1st Shift	End of 1st shift
OPERATIONAL DATA:	_____	_____	_____ a.m.	_____ a.m. p.m.

Vacations Holidays

SCHEDULED CLOSINGS: _____ _____

SQUARE FEET OF PLANT:_____

Have any new facilities been added during last 5 years? ___Yes ___No

If yes, what type of facilities?

What was approximate cost of recent additions? $_____

WHAT IS TOTAL ACREAGE AT THIS LOCATION?_____

IS SPACE AVAILABLE AT THIS LOCATION FOR EXPANSION? ___Yes ___No

If no, how would any expansion occur?

Are there any current plans for expansion or modernization of Physical Plant?

Production Capacity?

FUTURE PROSPECTS

a. What are the prospects for continued operation of this plant over the next 10-20 years?

b. What might be the relative expected scale of operations compared to today?

1) Employment:

Next 10 yrs.			Next 20 yrs.		
Up	Same	Down	Up	Same	Down
____%	____%	____%	____%	____%	____%

AND/OR

2) Energy Consumption:

Next 10 yrs.			Next 20 yrs.		
Up	Same	Down	Up	Same	Down
____%	____%	____%	____%	____%	____%

WHO ARE KEY PEOPLE INVOLVED IN

Initiating Request for Expenditure at Plant?

Approving Request for Expenditure At Plant:

At Corporate Level:

IF CITY OR COUNTY WISHED TO MAKE PROPOSAL FOR SALE OF RECOVERED ENERGY, WHO SHOULD THEY INITIALLY CONTACT?

Name_____ Title_____

Telephone No._____

Name_____ Title_____

Telephone No._____

Name_____ Title_____

TECHNICAL DATA

1. BOILERS	Number of Boilers			
	1	2	3	4
Number of boilers				
Make of boilers				
Date each installed				
Rated Steam Capacity				
Operating Capacity				
Hours/day operate				
Days/week operate				
Psigs/Temperature				
Types of fuel used (if coal is pulverized or crushed & dimension: same for wood wastes)				
Amount Fuel/yr/type				
For Solid Fuels: a. Ash handling capability				
b. Type of Grate System (traveling, spreader, etc.)				
For Oil: a. How fired				
b. Sulfur content				
c. Btu/gallon				
For Coal: a. Sulfur content				
b. Ash content				
c. Btu/lb or ton				
For Wood: a. Sulfur content				
b. Ash content				
c. Btu/lb or ton				

1. BOILERS (continued)

	Number of Boilers			
	1	2	3	4
Meeting Air Quality Standards: a. Air Particulates				
b. SO_2				
Type of pollution control equipment				
Initial Installation Cost				
Percent Depreciated				
Plans for Replacement: a. Date of installation				
b. Status of Design Work				
c. Date of Equipment Order				
d. Rated Capacity				
e. Make				
f. Fuel Type				
g. Estimated cost				
Other Technical Info (e.g., latest boiler inspection information)				

NOTES AND COMMENTS ON BOILERS:

FUEL

1. What is the current unit cost for fuel?

Oil:

a. High sulfur content_____¢/gal or $_____ /million Btu

b. Low sulfur content_____¢/gal or $_____ /million Btu

c. In what market(s) is oil purchased? _____

_____

d. Are above prices based upon

1) long-term contracts? ____yes ____no

2) short-term contracts? ____yes ____no

3) spot market? ____yes ____no

e. What is total annual expenditure? _____

f. What do you anticipate price to be in 1979 as result of OPEC action? $_____

Coal:

a. High sulfur content_____¢/gal or $_____ /million Btu

b. Low sulfur content_____¢/gal or $_____ /million Btu

c. In what market(s) is coal purchased?_____

_____

d. Are above prices based upon:

1) long-term contracts? ____yes ____no

2) short-term contracts? ____yes ____no

3) spot market? ____yes ____no

e. What is total annual expenditure? _____

f. Are escalators built into coal contracts? ____ yes ____no

If so, what are they?

g. Are there any circumstances affecting coal supply and/or prices which you anticipate will change costs this year and/or over the next 2-3 years?

Gas:

a. _____ /Therm/mcf interruptible

b. _____/Therm/mcf interstate

c. _____/Therm/mcf intrastate

Wood:

a. $_____/Ton purchased

b. Source

In-plant_____tons/day. Purchased _____ton/day.

STEAM

1. How much of the steam produced is used for

a. In-plant electricity production? _____ lbs @ _____psig _____F.

b. Auxiliary functions:

1) Air preheaters and aerators _____ lbs @ _____psig _____F.

2) Other (specify) _____ lbs @ _____psig _____F.

_____ lbs @ _____psig _____F.

_____ lbs @ _____psig _____F.

c. Industrial processes? _____ lbs @_____psig_____F.

d. Drying? _____ lbs @ _____psig_____F.

e. Heating and/or cooling? _____ lbs @ _____psig _____F.

f. Supplied to another company or plant?_____lbs @_____psig_____F

1) Identification of other establishment_____

2. Are hourly load duration curves available?

If no, then what are hourly steam production rates for 24-hour period?

Time	Hour		Hour		Hour		Hour	
_____ a.m.	1	_____ lbs.	2	_____ lbs.	3	_____ lbs.	4	_____ lbs.
	5	_____ lbs.	6	_____ lbs.	7	_____ lbs.	8	_____ lbs.
	9	_____ lbs.	10	_____ lbs.	11	_____ lbs.	12	_____ lbs.
	13	_____ lbs.	14	_____ lbs.	15	_____ lbs.	16	_____ lbs.
	17	_____ lbs.	18	_____ lbs.	19	_____ lbs.	20	_____ lbs.
	21	_____ lbs.	22	_____ lbs.	23	_____ lbs.	24	_____ lbs.

STEAM (continued)

3. Maximum hourly quantity of steam used_____lbs. Time of yr._____

4. Minimum hourly quantity of steam used_____lbs. Time of yr._____

5. Annual average monthly production of steam_____lbs.

6. Is condensate return provided? ___yes ____no. If yes, what percent of water consumption does this account for?_____% @ what temperature? _____F.

7. What is daily consumption of water? _____gallons (including condensate)

   Water Temperature: Winter_____F. Summer_____F.

   What is source of water supply?

   Public_____gal. Own Wells_____gal.

   Condensate_____gal.

8. What is the annual schedule for boiler maintenance?

9. Cost of Producing Steam

   a. Latest Fiscal Year Data on O&M costs for following categories:

Boiler System	$		$
Fuel		Residual Disposal	
Direct Labor Costs		Misc. (Identify)	
Indirect Labor Costs		Steam Distribution	
Chemicals		Direct Labor Costs	
Inventory of Parts		Indirect Labor Costs	
Replacement Parts		Inventory of Parts	
Scheduled Maintenance		Replacement Parts	
Pollution Control		Misc. (Identify)	
Wastewater Treatment		T O T A L	

b. What are the latest estimates for the cost of overhauling/modifying the existing boilers?

IN-PLANT ELECTRICITY PRODUCTION

	Number of Generators			
	1	2	3	4
Number of Generators				
Make				
Year Installed				
Megawatt Capacity				
Daily Operating Capacity				
Type of Generators: a. Condensing				
b. Extractive 1) Pounds @ psig/ temp, 1st stage				
2) Pounds @ psig/ temp, last stage				

Annual amount of electricity consumed _____ kwh

Percent accounted for by in-plant generation _____ %

INTEREST IN UTILIZING RECOVERED ENERGY

STEAM

If steam were provided on a reliable basis at the quality required:

a. How much steam on an hourly basis would plant be willing to purchase?

1) on an hourly basis _____ lbs.

2) on a monthly basis _____ lbs.

3) annually _____ lbs.

b. Would the company be willing to use its boilers as stand-by boilers only?____yes ____no.

1) If yes, which boilers would it consider for stand-by?____

_____

2) If yes, how many staff members would be retained?_____

_____

3) If yes, what would be fuel usage to keep boiler "warm"?

_____gal/_____

4) If previously shut down, how long would it take to fire boilers to operating conditions?

5) What would be the estimated yearly maintenance costs of keeping boilers "warm"?

c. Would the company be willing to enter into a long-term--10 to 20 years--contract for the purchase of steam? ____yes ____no

d. How should the price of steam be established?

e. Where would be the best location for a steam line hook-up?

f. What information would the company need in order for it to sign a letter of intent to purchase?

RDF (Ask only if solid fuels are used in boilers.)

If a dry solid by fuel were provided on a reliable basis as a supplement to existing fossil fuels:

a. How many tons per day could be utilized, assuming a heat value of 5500 Btu/pound?

_____ TPD

b. If RDF were to be used, which boilers would be considered for RDF?

1) Would any modifications be required? (Specify.)

2) Would special storage facilities be required? (Specify.)

If so, where should they be located?

3) Would the company be willing to pay the costs for any boiler modifications or storage facilities?

c. Would there be problems in receipt of RDF by tractor trailers?

d. What particle size and other specifications would be required for the RDF?

e. How should the price of RDF be established?

f. Would the company be willing to enter into long-term--10 to 20 years--contracts for the purchase of RDF?

g. What information would the company need in order for it it sign a letter of intent to purchase?

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